AN INVESTIGATION OF THE VALIDITY OF CERTAIN
APTITUDE TESTS IN PREDICTING ACADEMIC
PERFORMANCE IN THE NAVY MANAGEMENT
CURRICULUM OF THE UNITED STATES
NAVAL POSTGRADUATE SCHOOL

ROBERT KAUDER
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by

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Submitted in fulfillment of the

requirements of the course

INDIVIDUAL RESEARCH
MN 400

United States Naval Postgraduate School
Monterey, California

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ABSTRACT

Various aptitude test scores were correlated with academic grades received by military officers enrolled in the Navy Management Curriculum at the United States Naval Postgraduate School, Monterey, California. The resulting coefficients were analyzed to determine if the particular tests were valid predictors of academic achievement. Additionally, an analysis of the data was made using regression techniques in an attempt to provide an insight into possible cut-off scores for use in selecting candidates for the Navy Management Curriculum. The tests used in this study were the Navy Officer Classification Battery (OCB), the Graduate Record Examination (GRE), and the Navy Officer Qualification Test (OQT).

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CHAPTER I

THE PROBLEM AND DEFINITIONS OF TERMS USED

This paper may be considered as the third of a series dealing with coefficients of correlation derived from comparing aptitude tests scores and academic performance in the Navy Management Curriculum at the United States Naval Postgraduate School, Monterey, California. Previous papers in this area (see Bibliography) were prepared by Lieutenant Commander Bernard J. Bandish and Commanders David J. Martz and Thomas E. Rushin.

I. THE PROBLEM

Statement of the Problem. This research was undertaken (1) to determine if the Navy Officer Classification Battery (OCB) is a valid predictor of academic success in the Management Curriculum; (2) to compare the correlation coefficient of the OCB with the coefficient of the Graduate Record Examination (GRE) to determine which is the better predictor, all factors considered; (3) to learn how the Navy OCB test administered from five to thirteen years ago correlates with the OCB given at this time; (4) to determine how the Navy Officer Qualification Test (OQT) correlates with the OCB and with academic performance; and (5) to gain an insight regarding the establishment of possible cut-off scores for use in selecting Management Curriculum students.

II. DEFINITIONS OF TERMS USED

Officer Classification Battery (OCB) is a Navy edited examination consisting of five aptitude tests. In this study only two of the battery were involved. They were the Verbal Reasoning Test (NAVPERS 18325) and the Mathematics Test (NAVPERS 18327). This study dealt with OCB tests administered at different times. An OCB test, referred to in this paper as the "original OCB," was given to applicable officers shortly before or after commissioning. Another OCB, which the authors will refer to as the "second OCB," was administered to the entire student body enrolled in the Management Curriculum by the faculty of the Management Department. The two digit standard scores resulting from each segment of the OCB were combined into a weighted total score as described in Chapter IV. The total time allowed for these tests was 85 minutes.

Graduate Record Examination (GRE) is a nationally accepted test with a highly significant reliability coefficient designed to predict potential at the graduate level. This test is prepared by the Educational Testing Service, Princeton, New Jersey. In this study only the Aptitude Test, with its two segments Quantitative and Verbal, was involved. For the purposes of this paper the three digit scaled scores obtained for each segment were divided by ten to make the data compatible with the two digit OCB standard scores. The Aptitude Test total scaled scores is the addition of the two individual scaled scores. However in this paper a total weighted score was derived as described in Chapter IV which is expressed as a two digit number. Conversions from total weighted to total scaled scores are indicated on the X-axis of figures 4, 5 and 6. The total time allowed for the test was about three hours. The fee for

this examination is $2.50 per student.

Officer Qualification Test (OQT) was a Navy edited and administered test which was last used over 13 years ago. The test consisted of four parts of which only the Mathematics and Verbal tests were involved in this study. The total weighted scores of this test were derived in the same manner as was the OCB total test scores.

Quality Point Rating (QPR) refers to a student's weighted grade score computed from the following table of standards established by the U. S. Naval Postgraduate School:

Performance	Grade	Quality Point Number
Excellent	A	3.0
Good	B	2.0
Fair	C	1.0
Barely Passing	D	0.0
Failure	X	-1.0

Multiplying the term hour value for a particular course by the quality point number earned provides the quality point rating for that course. Adding the quality points accumulated for all courses and dividing by the total number of term hours will compute the Quality Point Rating (QPR).

Academic Success in the Management Curriculum is defined as the successful completion of the prescribed curriculum supported by a final minimum QPR of 2.00 which results in the awarding of the degree, Master of Science in Management, to otherwise qualified candidates.

Aptitude Tests are paper and pencil tests which are designed to predict the ability to learn in a specific area.

Validity Coefficient of Correlation is a single number indicating to what extent two things are related, i.e., to what extent variations in the one go with variations in the other. With the knowledge of how

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an aptitude test varies with academic performance, a single measurement
is made of the interdependence between the applicable variables. Through
the use of regression analysis (defined below) predictor data may be
generated from a validity coefficient. In general, when considering
correlations we may say that the strength of relationship can be
described roughly as follows for various validity coefficients:

      less than .20 . . . Slight; almost negligible relationship
            .20-.40 . . . Low Correlation; definite but small relationship
            .40-.70 . . . Moderate Correlation; substantial relationship
            .70-.90 . . . High Correlation; marked relationship
            .90-1.0 . . . Very high correlation; very dependable
                          relationship

Those who employ tests in guidance and selection feel that a
validity correlation should be at least .45 for material usefulness and
that best results come when the validity correlation (r) is above .60[1].

Regression Analysis which is sometimes referred to as "estimation"
or "prediction analysis" is expressing the relationship between two
variables as a mathematical function/equation, such as a straight line
which is called the line of regression. Once this is done it is possible
to predict one variable based upon the results obtained for the other
variable. However, due to sampling variations a confidence interval
should be constituted about the regression line. The width of this
confidence band will be based upon the particular degree of accuracy
desired for a prediction.

[1] J. P. Guilford, Fundamental Statistics in Psychology and Education
(first edition New York and London: McGraw-Hill Book Company, Inc.,
1942) p. 219

Reliability Coefficient of Correlation is a correlation of a test
with itself to determine to what extent results will be the same if the
test is retaken either in the same form, in alternate form, or by
splitting the same test into strictly comparable halves. A reliability
correlation coefficient of at least .80 is desirable for a test to be
considered reliable.

Confidence Level as used in this study relating to validity
coefficients is 95% and is the probability of being certain that the
true correlation coefficient for the entire population lies within a
given range. The confidence level (interval) used relative to the
regression analysis is 68% or plus/minus one standard deviation from
the line of regression.

CHAPTER II

ASSUMPTIONS AND LIMITATIONS

I. ASSUMPTIONS

It is assumed that by using statistically accepted methods for
computing correlation coefficients, the resulting data will be meaningful
in determining the validity or reliability of the test being considered.
However, due consideration must be given to the size of the sample
utilized. The formulae used for computing r from original data,
assigning statistical reliability to the coefficients obtained, and for
regression analysis are shown in Chapter IV. These formulae were
obtained from sources as indicated in applicable footnotes, and are
assumed by the authors to be appropriate for the purposes of this study.

Courses indicated in this study as being quantitative or verbal
in nature were so designated with the thought that one of the tests,
mathematics or verbal, was a better predictor of academic achievement
than the other. For example, the authors considered the mathematics
test to be a better predictor than was the verbal test of academic
performance for the course in Advanced Cost Accounting.

Even though slightly different criteria were used in the study made
in 1962 by Commanders Martz and Rushin regarding assignment of courses
into quantitative and verbal areas, enough similarity exists to permit
combining the two samples of 94 students each into one sample of 188.
In this regard only the test common to both groups for this size sample,
the GRE, will be analyzed and conclusions drawn therefrom.

II. LIMITATIONS

Due to time considerations this study used course grades generated up to and including the third term. There are certain factors which may tend to reflect higher QPRs during the fourth term and as a result affect higher total QPRs for the complete curriculum. Among these factors are (1) the fourth term contains no required quantitative courses, which to date have resulted in a mean QPR considerably less than that for the verbal courses, and (2) study habits should be reinforced and improved upon. A significant number of students with QPRs very close to 2.00 at the end of the third term may be expected to achieve a QPR of 2.00 or more. For example, as of the end of the third term there were seven students who required only one grade of A in a three hour course, combined with grades of at least B in the other courses taken, to acquire a 2.00 QPR for the academic year.

Different criteria in assigning grades to performance exist among individual instructors and this may have had some effect upon the data generated.

The prevailing system of assigning alphabetical course grades does not effectively discriminate between students whose performance is not the same. This is because identical grades may be assigned to students even though individual performance covers a relatively wide range. For example, there can be no distinction made between B+ and B= performance since both grades are assigned a quality point number of 2.00

Motivation must be recognized as a factor which may result in a student who scored below the mean in the GRE, for example, achieving a relatively high QPR. Occurrences such as this tend to distort the correlations.

CHAPTER III

DESCRIPTION OF THE FIVE CASES STUDIED

I. GENERAL

Table I shows the breakdown of ranks, designators, and segments of the military components comprising the 1963 student body represented in the five cases discussed below. The average age of the students was 34 years with a range of from 27 to 42. The mean commissioned service was 11 years with a range of from 5 to 18.

II. CASE 1

A sample of 94, which included the entire student officer body enrolled in the Management Curriculum. This group took the second OCB and the GRE tests previously described in Chapter I. These tests were administered two and three days prior to the commencement of the first term.

III. CASE 2

A sample of 58 students, part of the above mentioned 94, combining Cases 3 and 4 as indicated below.

IV. CASE 3

A sample of 12 students, part of the above 58, who upon commissioning took the Navy OQT prior to Navy use of the OCB. The data for this sample was furnished by the Bureau of Naval Personnel and was also obtained as required from individual personnel jackets in School files. This group was comprised of male U. S. Navy officers only. There was no information available regarding OQT scores for Marine Corps and Coast Guard officers.

V. CASE 4

A sample of 46, part of the above 58 students of Case 2, who had in prior years taken the original OCB. The data obtained was from the same sources as indicated for Case 3. This group was also composed of male U. S. Navy officers. There was no information available regarding OCB tests taken in prior years for Marine Corps or for Coast Guard officers.

VI. CASE 5

A sample of 188 students comprising both the 1962 and 1963 classes of the Management Curriculum. This Case was set up to analyze the correlation between GRE scores and academic performance using the largest combined sample available for study at this time.

TABLE I.

RANKS, DESIGNATORS AND MILITARY COMPONENTS OF
OFFICER STUDENTS OF THE NAVY MANAGEMENT CURRICULUM
UNITED STATES NAVAL POSTGRADUATE SCHOOL 1963 CLASS

Rank/Designator*	CDR	LCDR	LT	TOTALS
Line (1100)	4	3	11	18
Line (1310)		6	20	26
Line (other)		1	1	2
Supply (3100)	7	15	7	29
CEC (5100)		4	1	5
MSC (2300)		1	2	3
NC (2900)		2		2
USMC**		2	2	4
USCG		4	1	5
Totals	11	38	45	94

*Rank shown is rank held upon reporting to U. S. Naval Postgraduate
School.

**Ranks converted to Navy equivalent.

CHAPTER IV

METHODS AND PROCEDURES

I. GENERAL

The basic data used in this study was the academic scores achieved
and aptitude test scores previously described in Chapter I. The academic
and test scores are listed in Appendix A and B opposite an identification
code number randomly assigned to each student to preserve anonymity.
Total weighted test scores and weighted individual QPRs were derived as
explained in Section II below. Frequency distributions for math, verbal,
and total weighted criteria were drawn for the GRE, second OCB, and
QPR scores. These frequency charts with means and standard deviations
indicated thereon are presented as Figures 1, 2, and 3. Each frequency
distribution has a smooth curve fitted in accordance with procedures
described by Schlaifer.[1] EAM punched cards were prepared which included
all the data shown in Appendix B. Through the use of a computer program
this data generated correlation coefficients. Statistical reliability
of the coefficients was determined at the 95 per cent level. Through
regression analysis predictor data was then obtained.

[1] Robert Schlaifer, Introduction to Statistics for Business
Decisions (New York: McGraw-Hill Book Company, Inc., 1961) pp. 108-109

Figure 1

GRE FREQUENCY DISTRIBUTIONS
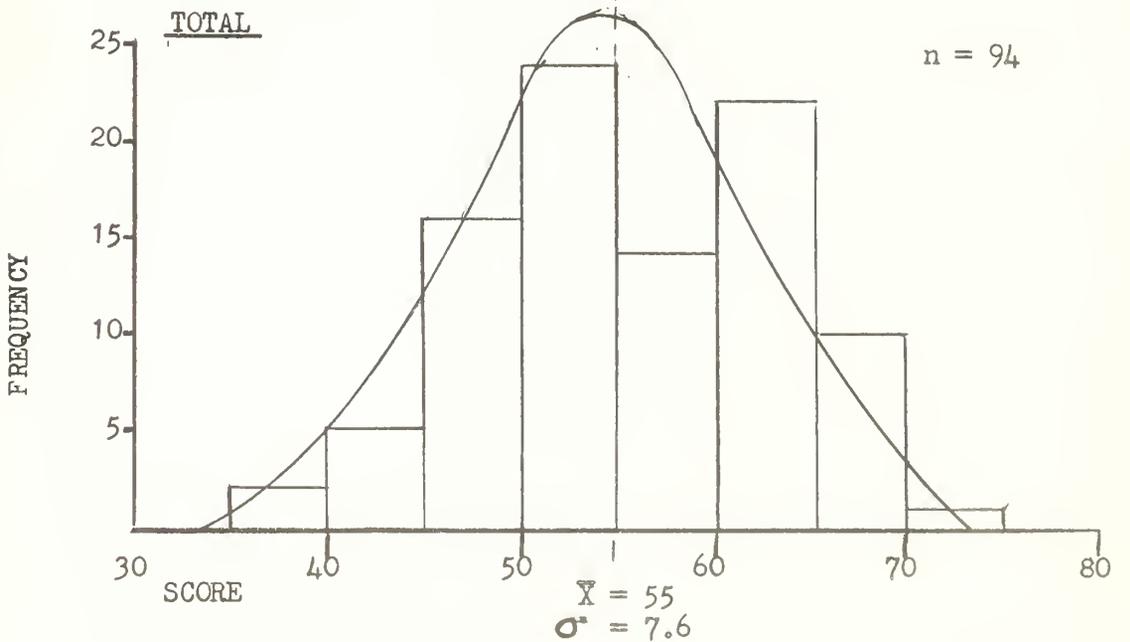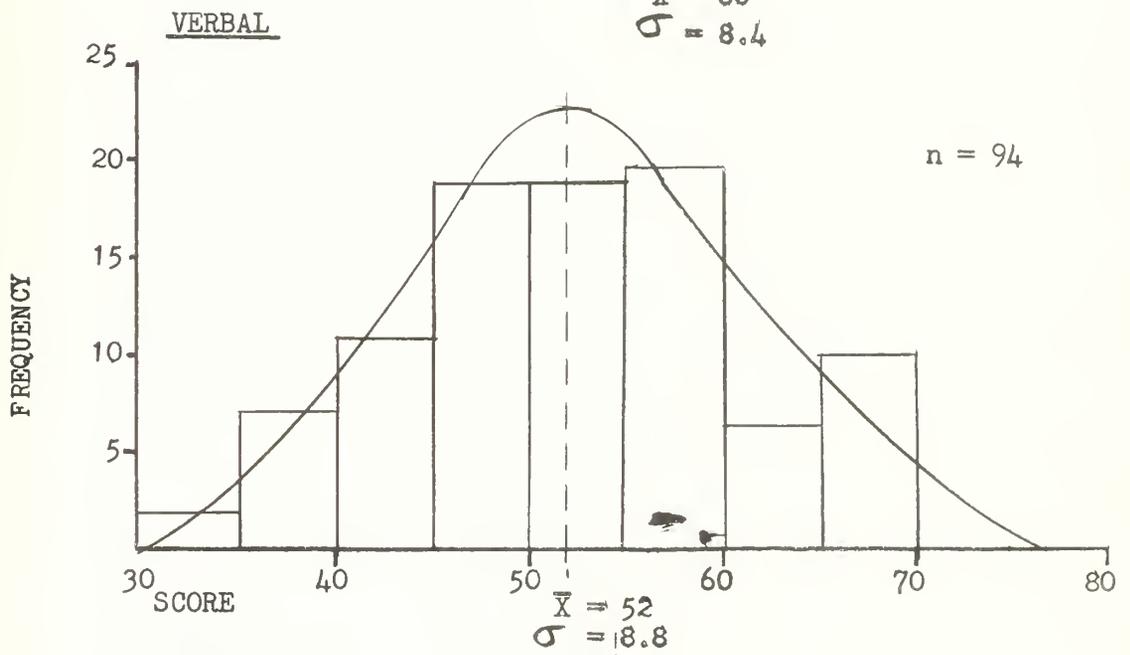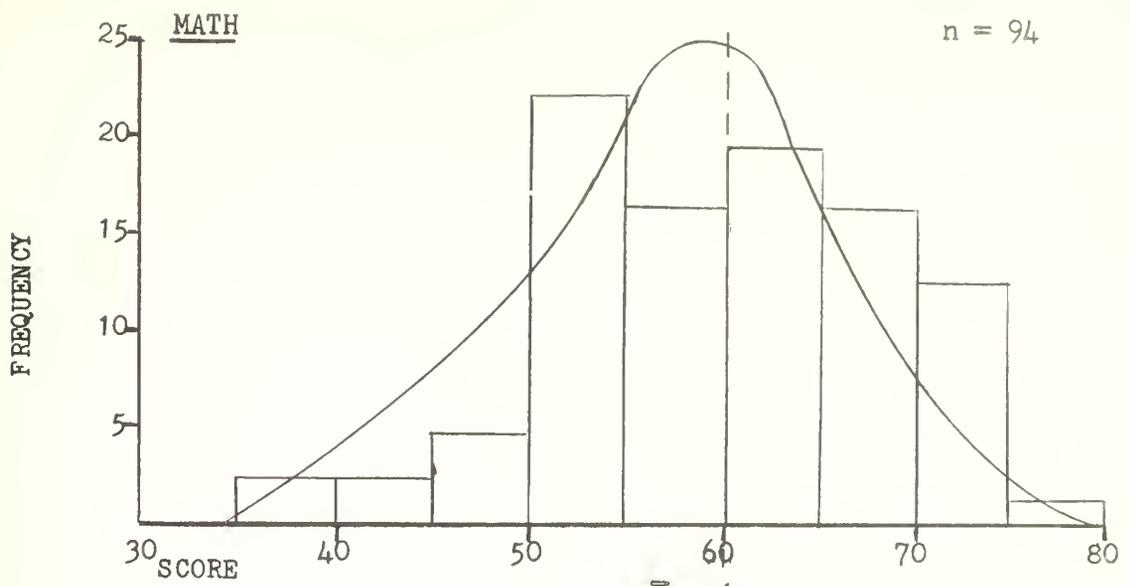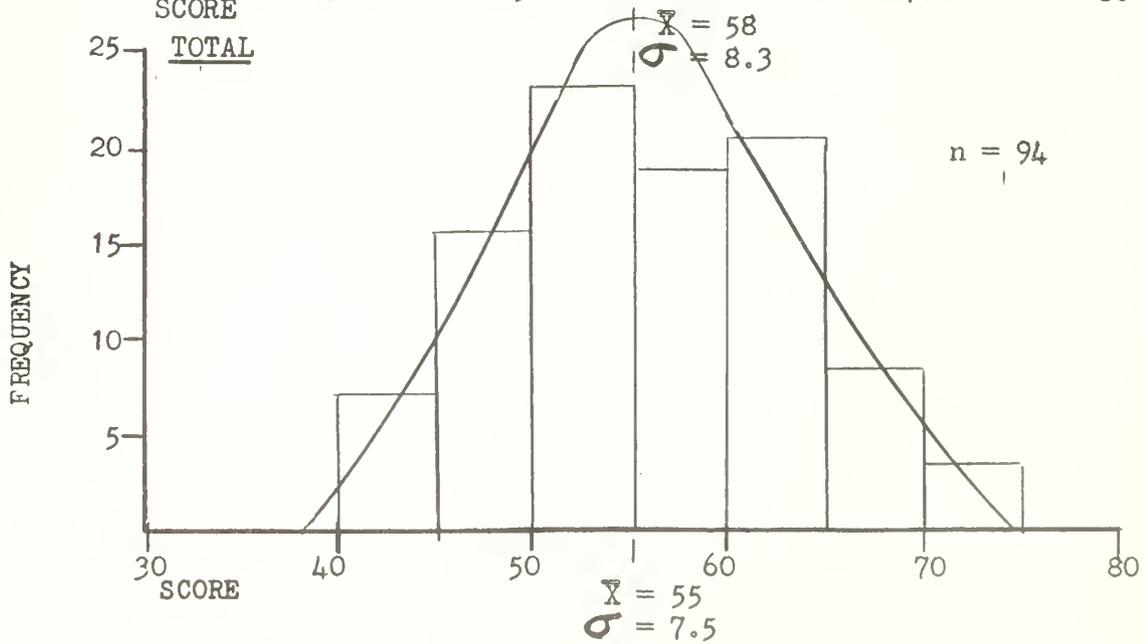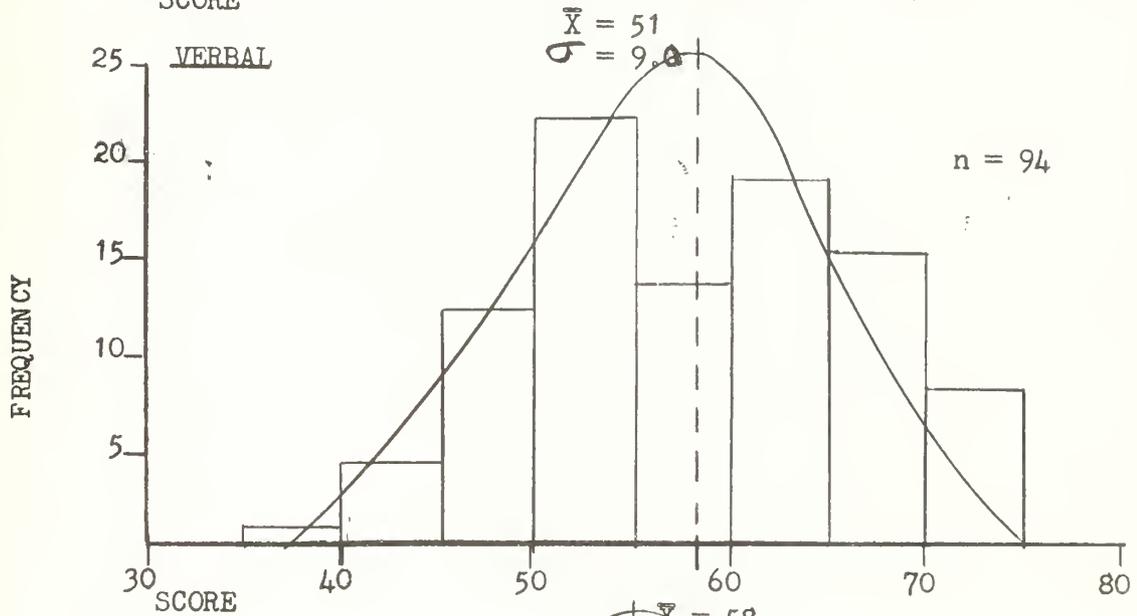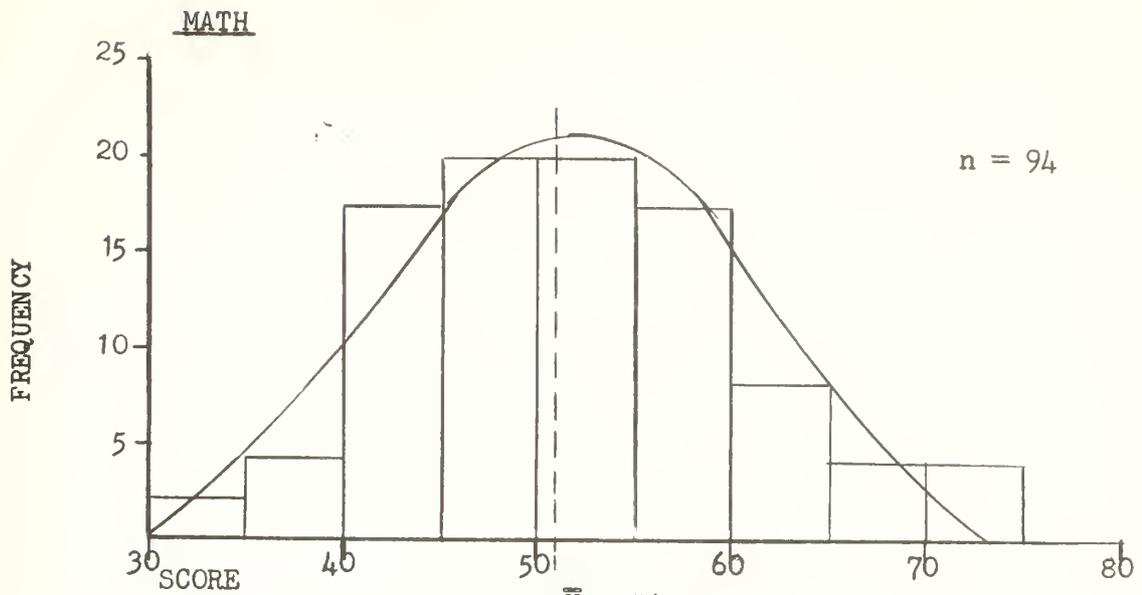
Figure 2

2ND OCB FREQUENCY DISTRIBUTIONS
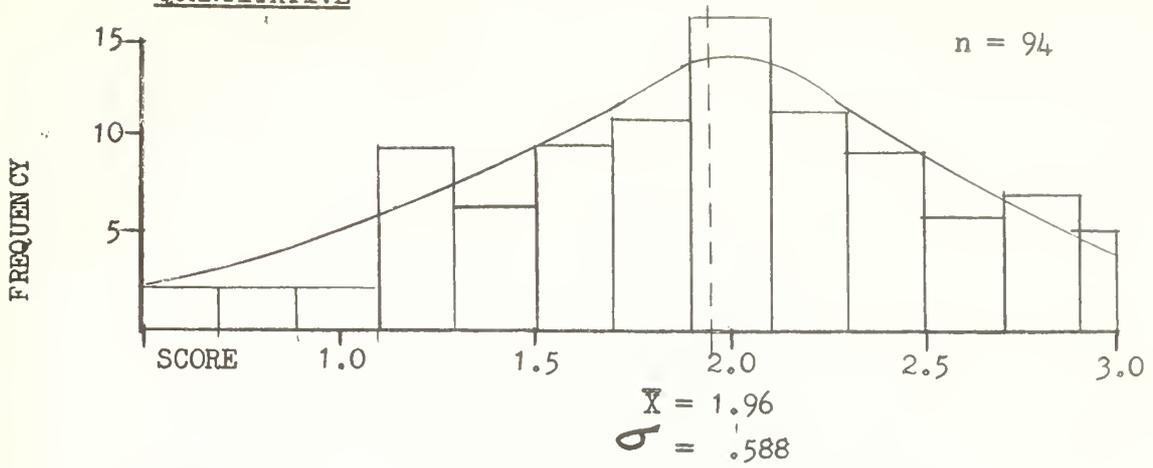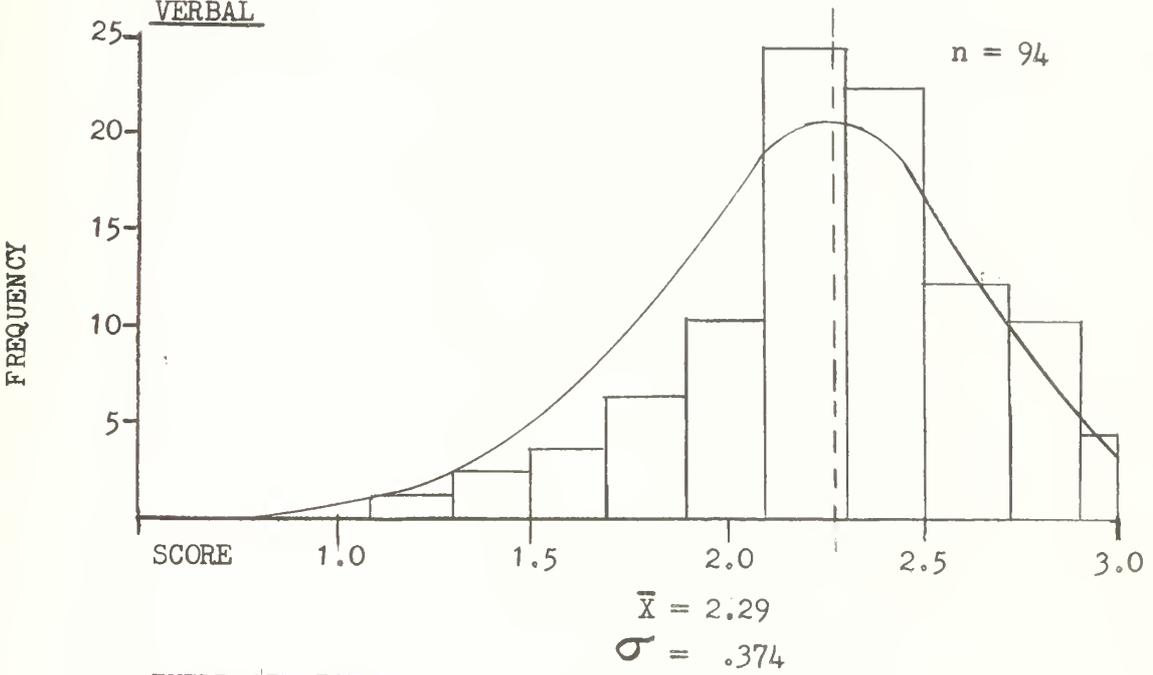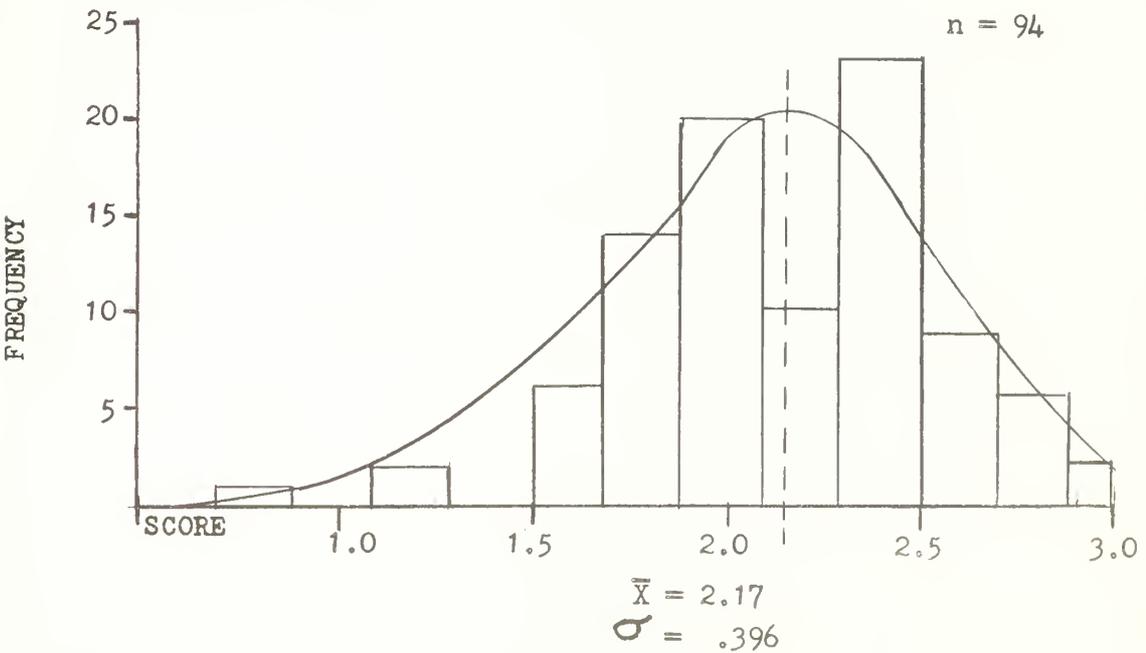
Figure 3

QPR FREQUENCY DISTRIBUTIONS

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II. WEIGHTING

The test scores and total QPR scores were weighted according to individual student term hours taken in both quantitative and verbal courses to obtain quantitative and verbal course QPR's and weighted total test scores. The data for student no. 1 will be used below to illustrate this technique. This student took a total of 47 class hours, 19 of which were in the quantitative area and 28 were in the verbal area. By multiplying the individual course hours times the quality points earned by virtue of the grades received for each course, totals of 45 and 67 quality points were obtained for the quantitative and verbal areas respectively. These amounts were then divided by the total class hours for quantitative and verbal courses to obtain a QPR for each area. In this case 45/19 = 2.37 (quantitative) and 67/28 = 2.39 (verbal). Weighted totals for the GRE, OCB (both), and OQT tests were derived by using as weights the ratios of quantitative course hours divided by total hours, and verbal course hours divided by total hours. In this case the ratios were 19/47 and 28/47 or .40 and .60. These ratios were applied as follows using the original OCB to illustrate:

Math Standard Score times quantitative ratio   43 x .40 = 17.2
Verbal Standard Score times verbal ratio   47 x .60 = $\underline{28.2}$
    Total Weighted Original OCB score   45.4

The above procedure was used to obtain weighted total scores for all tests involved in this study and to obtain quantitative and verbal QPR scores for all students. These weighted scores are presented in Appendices A and B.

III. CORRELATION ANALYSIS

The Appendix B data was key punched onto EAM cards which were segregated into five individual cases. These cases were composed of the variables shown below:

<u>Case 1</u>.   94 Students - 9 variables

      GRE Math Score
      GRE Verbal Score
      GRE Weighted Total Score
      Second OCB Math Score
      Second OCB Verbal Score
      Second OCB Weighted Total Score
      QPR Weighted Quantitative Score
      QPR Weighted Verbal Score
      QPR Total Score

<u>Case 2</u>.   58 Students - 6 variables

      Original OCB and OQT Math Score
      Original OCB and OQT Verbal Score
      Original OCB and OQT Weighted Total Score
      QPR Weighted Quantitative Score
      QPR Weighted Verbal Score
      QPR Total Score

<u>Case 3</u>.   12 Students - 6 variables

      OQT Math Score
      OQT Verbal Score
      OQT Weighted Total Score
      QPR Weighted Quantitative Score
      QPR Weighted Verbal Score
      QPR Total Score

<u>Case 4</u>.   46 Students - 6 variables

      Original OCB Math Score
      Original OCB Verbal Score
      Original Weighted Total Score
      QPR Weighted Quantitative Score
      QPR Weighted Verbal Score
      QPR Total Score

<u>Case 5</u>. 188 Students – 6 variables

      1962 and 1963 GRE Math Scores
      1962 and 1963 GRE Verbal Scores
      1962 and 1963 GRE Weighted Total Scores
      1962 and 1963 Weighted QPR Quantitative Scores
      1962 and 1963 Weighted QPR Verbal Scores
      1962 and 1963 Total QPR Scores

Statistical comparison of this data was achieved through the use of the following formula which was programmed for use on the IBM 1401 computer.[2]

$$(1) \quad r_{xy} = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{\left[N\sum X^2 - (\sum X)^2\right]\left[N\sum Y^2 - (\sum Y)^2\right]}}$$

where:

    r_{xy} = correlation between X and Y
    X = applicable test scores of the sample
    Y = applicable QPR scores of the sample
    N = sample size

This program yielded a coefficient of correlation between every variable included in each case. In addition, the mean and standard deviation (of the sample) was computed for each of the individual 18 variables.

The coefficients are shown in Tables II through VI under the heading "Correlation Analysis." Table VII indicates the means and standard deviations obtained.

This program was also utilized to determine the reliability coefficient of correlation of the OCB when comparing the original OCB versus the second OCB. The sample considered was those students

[2]
  J. P. Guilford, <u>Fundamental Statistics in Psychology and Education</u> (first edition New York and London: McGraw-Hill Book Company, Inc., 1942) p. 219

TABLES OF VALIDITY CORRELATION COEFFICIENTS

TABLE II, CASE 1, n = 94

CORRELATION ANALYSIS

QPR / TEST	QUANTITATIVE	VERBAL	3RD QTR TOTAL
GRE-MATH	.3828	.3773	.4230
GRE-VERBAL	.4056	.5650	.5436
GRE-TOTAL	.4784	.5657	.5826

Statistical Reliability - 95% Confidence Level

TEST / QPR	RANGE
GRE-MATH/QPR QUANTITATIVE	.2093 to .5563
GRE-VERBAL/QPR VERBAL	.4265 to .7035
GRE-TOTAL/QPR TOTAL	.4481 to .7171

CORRELATION ANALYSIS

QPR / TEST	QUANTITATIVE	VERBAL	3RD QTR TOTAL
2nd OCB-MATH	.2906	.2925	.3140
2nd OCB-VERBAL	.2404	.4301	.3641
2nd OCB-TOTAL	.2864	.4209	.3841

Statistical Reliability - 95% Confidence Level

TEST / QPR	RANGE
2nd OCB-MATH/QPR QUANTITATIVE	.1041 to .4771
2nd OCB-VERBAL/QPR VERBAL	.2628 to .5974
2nd OCB-TOTAL/QPR TOTAL	.2109 to .5573

TABLE III, CASE 2, n = 58

CORRELATION ANALYSIS

QPR / TEST	QUANTITATIVE	VERBAL	3RD QTR TOTAL
Orig OCB plus OQT-Math	.0055	.1234	.0477
Orig OCB plus OQT-Verbal	.0893	.2486	.1866
Orig OCB plus OQT-Total	.0725	.2550	.1696

Statistical Reliability - 95% Confidence Level

TEST / QPR	RANGE
Orig OCB plus OQT-Math/QPR Quant	(-).2505 to .2615
Orig OCB plus OQT-Verbal/QPR Verbal	.1496 to .3476
Orig OCB plus OQT-Total/QPR Total	(-).0159 to .3551

TABLE IV, CASE 3, n = 12

CORRELATION ANALYSIS

QPR / TEST	QUANTITATIVE	VERBAL	3RD QTR TOTAL
OQT-Math	.0237	.4165	.2215
OQT-Verbal	.0340	.1008	.0853
OQT-Total	.0798	.2965	.2027

Statistical Reliability - 95% Confidence Level

TEST / QPR	RANGE
OQT-Math/QPR Quantitative	(-).5663 to .6137
OQT-Verbal/QPR Verbal	(-).4832 tc .6848
OQT-Total/QPR Total	(-).3533 to .7687

TABLE V, CASE 4, n = 46

CORRELATION ANALYSIS

QPR / TEST	QUANTITATIVE	VERBAL	3RD QTR TOTAL
Orig OCB-Math	.0343	.0523	.0271
Orig OCB-Verbal	.0290	.3335	.1899
Orig OCB-Total	.0252	.2493	.1350

Statistical Reliability - 95% Confidence Level

TEST / QPR	RANGE
Orig OCB-Math/QPR Quant	(-).2587 to .3263
Orig OCB-Verbal/QPR Verbal	.0840 to .5830
Orig OCB-Total/QPR Total	(-).1520 to .4220

TABLE VI, CASE 5, n = 188

CORRELATION ANALYSIS

QPR / TEST	QUANTITATIVE	VERBAL	3RD QTR TOTAL
GRE-Math	.4802	.3889	.4449
GRE-Verbal	.3988	.5114	.5024
GRE-Total	.4455	.4908	.5014

Statistical Reliability - 95% Confidence Level

TEST / QPR	RANGE
GRE-Math/QPR Quantitative	.3701 to .5903
GRE-Verbal/QPR Verbal	.4057 to .6171
GRE-Total/QPR Total	.3940 to .6088

TABLE VII

MEANS AND STANDARD DEVIATIONS

QPR/TEST	Means		Standard Deviations (sample)		Standard Deviations (est. of population)
QPR Quantitative	1.9587		.5880		.5943
QPR Verbal	2.2927		.3743		.3783
QPR Total	2.1700		.3965		.4007
GRE Math (N = 94)	59.5000	(48.0)**	8.3714	(9.4)**	8.4614
GRE Verbal (N = 94)	51.6809	(49.2)**	8.8031	(9.8)**	8.8977
GRE Weighted Total (N = 94)	54.8245		7.5871		7.6686
Original OCB Math	52.6304	(50.0)*	7.5480	(10.0)*	7.7157
Original OCB Verbal	54.5217	(")	7.0333	(")	7.1896
Original OCB Weighted Total	53.8240	(")	6.3399	(")	6.4808
Second OCB Math	51.4681	(50.0)*	8.9534	(10.0)*	9.0497
Second OCB Verbal	57.6383	(")	8.2846	(")	8.3737
Second OCB Weighted Total	55.3149	(")	7.4661	(")	7.5464
GRE Math (N = 188)	59.6064	(48.0)**	9.5396	(9.4)**	9.5907
GRE Verbal (N = 188)	52.1808	(49.2)**	8.7913	(9.8)**	8.8383
GRE Weighted Total (N = 188)	54.3856		8.0477		8.0907
OQT Math	56.5000		8.8365		9.6398
OQT Verbal	43.3333		7.3182		7.9835
OQT Weighted Total	48.8583		6.7057		7.3153

* Standard Norms   ** National Norms

comprising Case 4, sample size 46, who had taken both OCBs. The reliability coefficients obtained are discussed in Chapter V.

IV. STATISTICAL RELIABILITY

Since the computed correlation coefficient was derived from a limited sample it can not exactly represent the true coefficient (r) of the population of potential officer students. However, by determining the standard error about the sample coefficients we can say, with selected degrees of confidence, how much from the true r of the population any sample of the sizes used in this study would probably exhibit. By assuming that the true r is equal to our obtained one, we can estimate the standard error of the sample coefficients about this value by means of the following formula:[3]

$$(2)\ \sigma_r = \frac{1-r^2_{xy}}{\sqrt{N-1}}$$

where:

σ_r = standard error of sample coefficients

r_{xy} = correlation between X and Y

N = sample size

To provide limits between which we can be 95 per cent certain the true r lies the cumulative unit normal distribution yields 1.96 as the value by which σ_r is multiplied to establish the range. To illustrate this procedure the computation for GRE verbal scores versus QPR verbal scores for Case 1 is shown below.

[3] Ibid., p. 209.

By using formula (2) we have:

$$\sigma_r = \frac{1 - (.5650)^2}{\sqrt{94-1}} = .0707$$

limit interval = $r_{xy} \pm 1.96\sigma_r = \pm .1385$

therefore: .5650 + .1385 = .7335 upper limit
.5650 - .1385 = .4265 lower limit

Now we may say that we are 95 per cent confident that the true r
of the population lies between .4265 and .7035. Ranges have been
computed for the validity coefficients of all test scores versus
performance at the 95 per cent level of confidence. These ranges may be
found for each Case in Tables II through VI under the heading
"Statistical Reliability."

V. REGRESSION ANALYSIS

While the statistical reliability analysis previously described
establishes validity coefficient of correlation confidence levels for
particular tests, this information in itself cannot be used to predict
an individual's academic success. However, through the use of regression
analysis for a particular test we can predict the QPR of an individual,
within a desired confidence limit, based upon his score on this test.
This can be accomplished by establishing a line of regression for known
test versus academic results and expressing this linear function as an
algebraic equation. In order to use the line of regression for predict-
ion purposes, the margin of error of prediction or standard deviation,
from a line of regression must be determined. Once this standard error
has been computed we can, based upon the confidence level desired,
predict academic success when we have known test results.

The line of regression equation is obtained by using the following formula:[4]

(3) $Y' = r\left(\dfrac{\sigma y}{\sigma x}\right)\left(X-Mx\right) + My$

where:

Y' = a predicted QPR based upon a known test score

$r = r_{xy}$ = correlation between QPR's (Y) and test scores (X)

σy = standard error of the QPR's achieved by the student body sample

σx = standard error of the test scores achieved by the student body sample

X = the test score achieved by an individual for which prediction of a QPR is desired

M_x = mean of the sample test scores

M_y = mean of the sample QPR scores

To illustrate this technique for the total QPR and total GRE results obtained in Case 1, we have using formula (3):

$Y' = .5826\left(\dfrac{.3965}{7.5871}\right)(X-54.8245) + 2.1700 = .0304X + .50$

This gives us a line of regression equation for predicting QPR's based upon GRE scores. The standard error of this equation is computed using the following formula:[5]

(4) $\sigma_{yx} = \sigma_y \sqrt{1-r^2_{yx}}$

where:

σ_{yx} = standard error or standard deviation of the estimation of QPR's (Y) based upon test scores (X)

σ_y = standard deviation (error) of the QPR's achieved by the sample

$r_{yx} = r_{xy}$ = correlation between QPR's (Y) and test scores (X)

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[4] Ibid.,pp. 213-214.

[5] Ibid.,p. 216.

Again, using the total QPR versus GRE scores as an example we can establish a confidence interval or band about the line of regression previously described. At the 68 per cent confidence level, or plus or minus one standard deviation, we have using formula (4):

$$\sigma_{yx} = .3965 \sqrt{1-(.5826)^2} = .32$$

limit interval for $Y' = .0304X + .50 \pm (1.00)(.32)$

Lines of regression equations were determined and are presented and plotted as solid lines in Figures 4 and 5 for the 1963 and combined 1962/1963 classes, respectively. Due to the significant shift of the line of regression for the composite group, a line of regression was plotted for the 1962 class, using data accumulated by Commanders Martz and Rushin,[6] in order to compare the two classes. This chart is depicted in Figure 6. The confidence interval in all Figures was established as one standard deviation and is represented by the dotted lines on each chart. Using this confidence level we can say we are 68 per cent confident an individual's QPR will fall within the indicated range based upon his test score. To put it another way, he has an 84 per cent probability of achieving a QPR equal to or greater than that QPR indicated by the intersection of the lower confidence limit (minus one standard deviation) and his achieved test score.

[6]David J. Martz and Thomas E. Rushin, "Valid Criteria for Selecting Postgraduate Management School Candidates on the Basis of Established Academic Performance and Various Aptitude Tests" (unpublished Research Paper, United States Naval Postgraduate School, Monterey, California, May 1962) pp. 21-22.
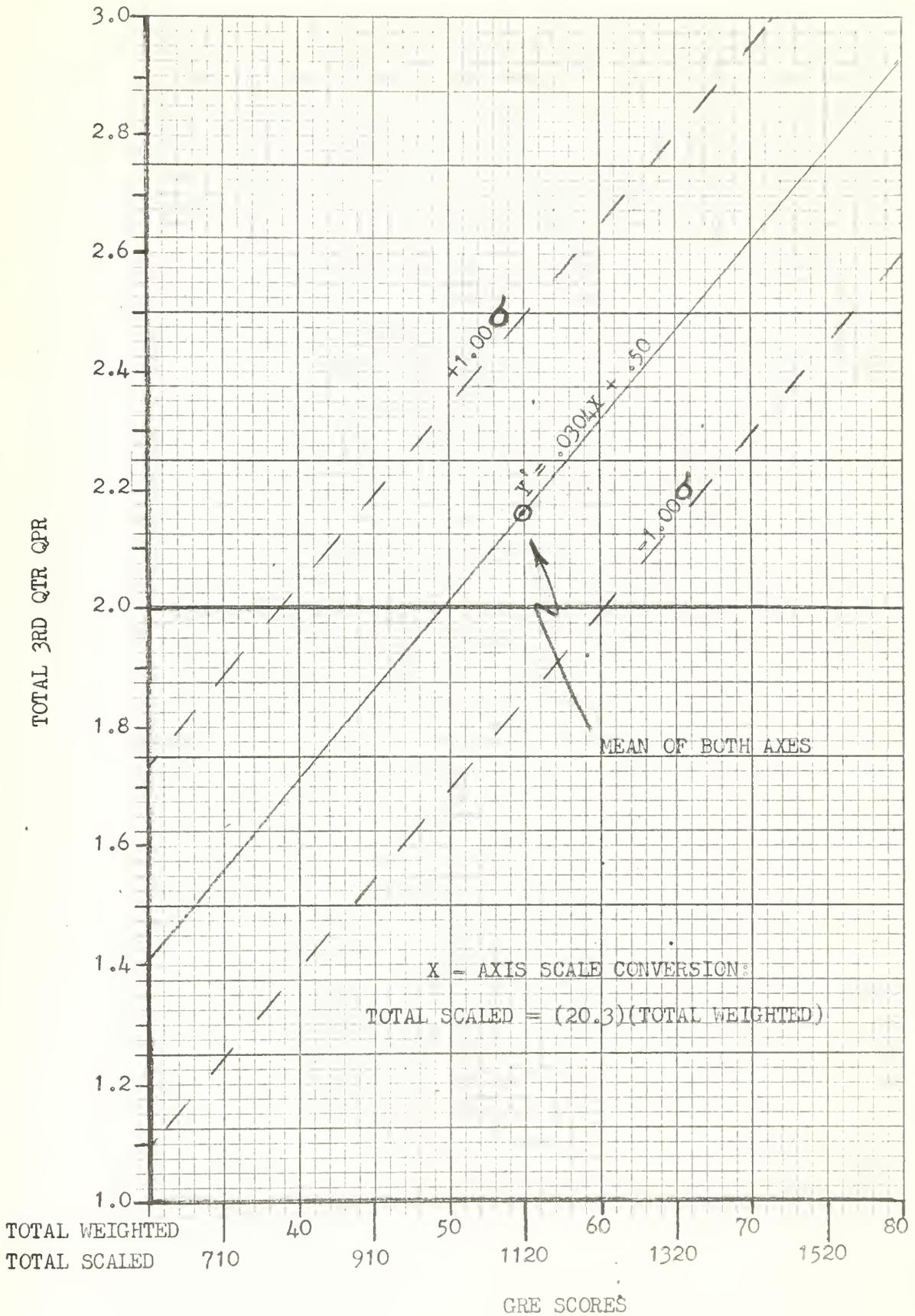
Figure 4

Line of Regression Based Upon
1963 Class, n = 94
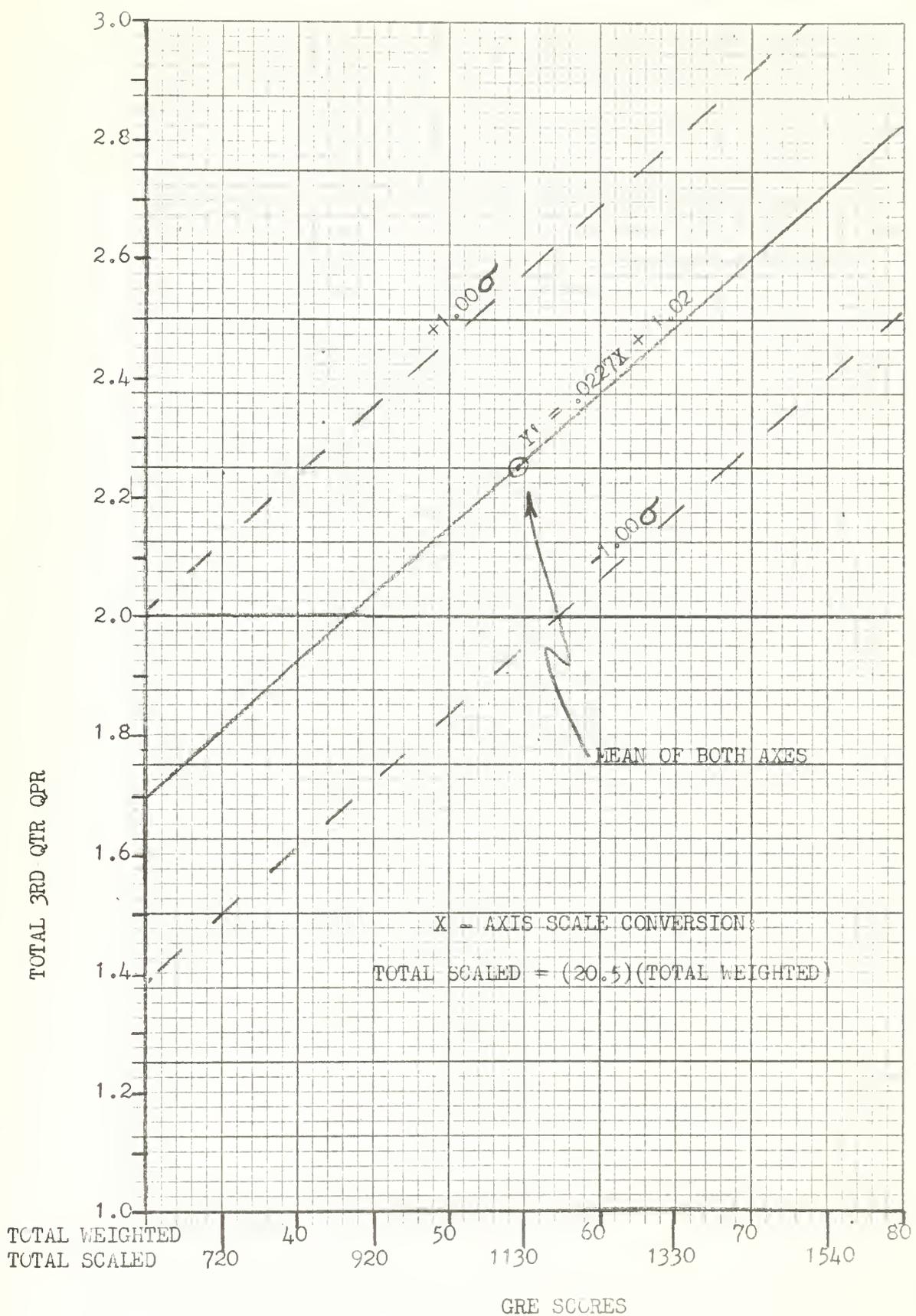
Figure 5

Line of Regression Based Upon Combined
1962/1963 Classes, n = 188

27
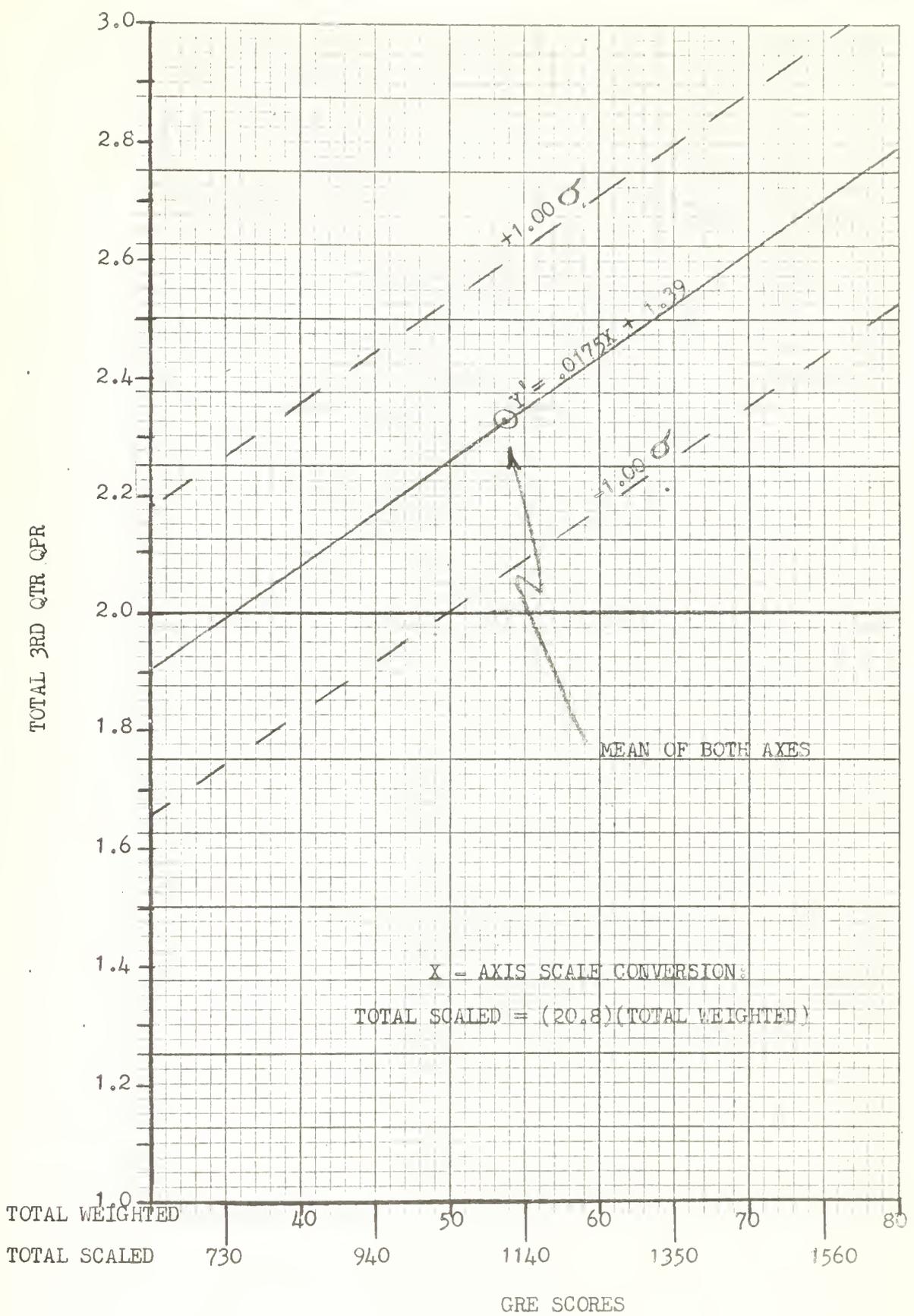
Figure 6

Line of Regression Based Upon
1962 Class, n = 94

CHAPTER V

RESULTS OF THE STUDY

I. CASE 1 - GRE AND SECOND OCB

Considering the total scores for each test, analysis of this
correlation revealed the GRE versus QPR coefficient is .5826 as
compared with .3841 for the second OCB. In the quantitative and
verbal areas, individually, the GRE was found to possess a validity
correlation approximately 25 per cent greater than that of the second OCB.
Additionally, the statistical reliability computation for the GRE versus
QPR totals relationship reveals that we can be 95 per cent confident that
the true r of the population lies between .4481 and .7171. These limits
for the second OCB versus QPR totals are from .2109 to .5573.

The frequency distribution for both tests, as smoothed in
Figures 1 and 2, pages 12 and 13, have a bell-shaped configuration which
illustrates the normal tendency of these tests when applied to a sample
possessing the same general characteristics as the present student body.

Because of the superior validity correlation of the GRE over the
second OCB, regression analysis was only performed for the GRE. Based
upon the present (1963) class it was found, as indicated in Figure 4,
page 26, that a total scaled GRE score of 1220 acquired by a potential
student would mean that he has a probability of .68 of achieving a total
QPR between 2.00 and 2.65. The same student would have a 85 per cent
chance of obtaining a QPR equal to or greater than 2.00. A student
having the mean total scaled score of the sample (1110), should achieve
a QPR of 1.83 or greater at the same confidence level (.84).

From Figure 5, page 27, we found by combining the two classes (1962 and 1963) a total scaled score of 1170 is necessary to achieve academic success at the 84 per cent confidence level. To determine the cause for this shift in the line of regression, regression analysis was made for the 1962 class in Figure 6, page 28. We now find a total GRE scaled score of only 1030 is required for a student to be 84 per cent confident of achieving a QPR of 2.00 or greater.

The preceding two paragraphs deal only with data generated for three terms, and we may therefore expect that by using data generated for the full academic year, cut-off scores would be lower to achieve the same QPR predictions indicated above.

A disparity between the 1962 and 1963 classes' total scaled scores necessary to predict academic success, at the same confidence level, is evident. Factors which we would expect to preclude such a disparity are: (1) the sample sizes are the same; (2) the mean ages of the two samples are within one year of each other; (3) the mean length of commissioned service is within one year; (4) the rank/designator composition of the two samples is essentially the same; (5) the data used for both classes was compiled as of the end of the third term and most importantly, (6) the mean total scaled GRE test score of each sample varies by less than 1 per cent; i.e. 1962 - 1120; 1963 - 1110.

II. CASE 2 - ORIGINAL OCB AND OQT

In order to determine if it was valid to combine these two tests and treat them as one sample of 58, an intercorrelation of the 12 students who had taken both the second OCB and the OQT was obtained for the weighted totals and produced a reliability coefficient of only .61.

The difference between these tests' means of 5.82 is high. Since the original OCB is the same test as the second OCB it is considered that Case 2 data, which combined the original OCB and the OQT, does not have any significant meaning.

III. CASE 3 – OQT

The correlation coefficient for the OQT versus QPR total scores is .2027, and due to the very small sample of 12, produced a statistical reliability range from (-).3533 to .7687. This information is not useful in view of the large spread.

IV. CASE 4 – ORIGINAL OCB

The original OCB weighted total scores versus total QPR scores yielded the extremely low validity coefficient of .1350 with a statistical reliability range of from (-).1520 to .4220.

The reliability coefficient of correlation between the original OCB and the second OCB for the same students resulted in the following coefficients: math = .6226; verbal =.7404; and weighted totals = .7348. These coefficients are considerably less than the accepted minimum of .80.

V. CASE 5 – 1962/1963 COMBINED GRE

This correlation study produced a coefficient of .5014 for GRE versus QPR total scores with a statistical reliability range of from .3940 to.6088. It should be noted that the range of grades for the 1962 class was from 1.54 to 3.00 QPR, with a mean total QPR of 2.33, while the range for the 1963 class is from .089 to 3.00 QPR with a mean total QPR of 2.17. The correlation coefficient for the entire class GRE

versus QPR totals was .4839.[1] With a wider spread of QPR scores for the 1963 class the correlation coefficient as previously noted was .5826. Regression analysis of this Case was discussed in Section I above.

[1] David J. Martz and Thomas E. Rushin, "Valid Criteria for Selecting Postgraduate Management School Candidates on the Basis of Established Academic Performance and Various Aptitude Tests" (unpublished Research Paper, United States Naval Postgraduate School, Monterey, California, May 1962) pp. 21, 22, 23 and 29.

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

I. CONCLUSIONS

1. Considering the tests involved in this study, the GRE proved to have high validity and is the best predictor of academic success in both the quantitative and verbal areas.

2. Neither the original nor the second OCB can, from a statistical standpoint, be considered a valid predictor of academic achievement in the curriculum.

3. The OCB, based upon our sample size of 46, does not indicate a high enough degree of reliability over a time span of several years.

4. The OQT, as a result of the data generated from a sample size of 12, was found not to be interchangeable with the OCB, and to have an extremely low validity coefficient when related to QPR scores. However, because of the very small sample size involved, these results are considered to be meaningless.

5. Based upon the regression analysis, cut-off scores for the GRE in selecting Management Curriculum students are extremely difficult to establish at this time. This is because: (1) our regression analysis is applicable for prediction as of the end of the third term only and (2) there exists a wide differential in academic performance between the 1962 and 1963 classes. A 1962 student with a total scaled score of 1030 had an 85 per cent chance of achieving a QPR of at least 2.00. The same GRE score in the 1963 group, at the same confidence level, predicts a QPR of only 1.72 or greater.

Since the two classes are essentially statistically identical in all respects, excluding such unmeasureable personal factors as motivation, there should be an assignable cause for this disparity. This cause, the authors feel, is the use of different grading standards for the two classes. An indication as to why the different standards exist may be the approximately 50 per cent turn-over in faculty members which took place subsequent to the conclusion of the third term 1962 and prior to the commencement of the 1963 class. Increasing the sample size for regression analysis as in Case 5 tends to smooth out these grading standard differences and makes the establishing of cut-off scores somewhat more feasible. Additionally, a truer picture of the GRE score needed for academic success could be obtained by utilizing QPR's for the entire academic year.

II. RECOMMENDATIONS

1. It is recommended the GRE be administered to officers after they have been initially selected for Navy Management Postgraduate education based upon their records. Utilizing cut-off scores, if developed, or by simple ranking, the final selection could be effected.

2. It is recommended investigation be made as to the present utilization of the OCB, since the math and verbal segments may prove to be unreliable over a long time span. Additionally, these segments have too low a validity for use in predicting performance for potential Navy Management Curriculum students.

3. It is recommended that future studies in the area of validation of tests be continued with the aim of (1) extending this study to take in the fourth term; (2) using regression techniques as indicated in

Chapter IV to develop cut-off score guidelines at specified levels of confidence. The program used in this study as well as the punched cards and other pertinent working papers are being retained by the Management Department for future reference.

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APPENDICES

ACADEMIC SCORES

		VERBAL SUBJECTS										QUANTITATIVE SUBJECTS									
Student Identification Number	Third Quarter Total Quality Point Rating	Verbal Area Quality Point Rating Mn-495 (3 hrs)	Org & Mgmt Seminar Mn-495 (3 hrs)	Procurement & Cont Admin Mn-461 (3 hrs)	Auditing Mn-421 (3 hrs)	Pers Admin & Ind Rel Mn-453 (4 hrs)	Mgmt Economics Mn-410 (5 hrs)	Financial Mgmt II Mn-421 (4 hrs)	Org. Theory & Mgmt Mn-490 (5 hrs)	Material Mgmt Mn-463 (3 hrs)	Mgmt Psychology Mn-452 (4 hrs)	Quantitative Area Quality Point Rating	Adv. Cost Accounting Mn-423 (3 hrs)	Economic Analysis Mn-413 (3 hrs)	Industrial Mgmt Mn-440 (4 hrs)	EDP & Mgmt Control Ma-471 (3 hrs)	Ops Analysis for Mgt QA-471 (4 hrs)	Quantitative Methods Mn-470 (8 hrs)	Financial Mgmt I Mn-420 (4 hrs)	Mgmt Statistics Ma-371 (4 hrs)	Calculus for Mgmt Ma-170 (4 hrs)
01	2.38	2.39		A		B	B	A	B	B	A	2.37	A		B				B	A	
02	1.81	2.23		A	A	A	C	B	C	A	A	1.00			B					C	D
03	2.70	2.89	B			A	A	A	A	A	A	2.42	B		B				A	B	
04	2.60	2.46	A			B	A	B	B	B	B	2.79	A		B		B		A	A	C
05	2.17	2.36			A	B	A	B	B	B	A	1.95	A				B	B		B	
06	3.00	3.00	A		A	A	A	A	A	A	A	3.00			A				A	A	
07	1.87	1.94	B		A	B	C	B	B	B	B	1.75			B				B	C	
08	2.47	2.71	A	A		A	A	B	B	A	A	2.00			B				B	B	
09	2.53	2.55	B	A		A	A	B	A	B	B	2.50			B				A	B	
10	2.05	2.39	A	A		A	B	B	B	B	A	1.58	B		B				C	B	

ACADEMIC SCORES

Student ID	Calculus for Mgmt Ma-170 (4 hrs)	Mgmt Statistics Ma-371 (4 hrs)	Financial Mgmt I Mn-420 (4 hrs)	Quantitative Methods Mn-470 (8 hrs)	EDP & Mgmt Ops Analysis for Mgt OA-471 (4 hrs)	Industrial Mgmt & Mgmt Control Ma-471 (3 hrs)	Economic Analysis Mn-440 (4 hrs)	Adv. Cost Accounting Mn-423 (3 hrs)	Quantitative Area Quality Point Rating	Mgmt Psychology Mn-452 (4 hrs)	Material Mgmt Mn-463 (3 hrs)	Org. Theory & Mgmt Mn-490 (5 hrs)	Financial Mgmt II Mn-421 (4 hrs)	Mgmt Economics Mn-410 (5 hrs)	Pers Admin & Ind Rel Mn-453 (4 hrs)	Auditing Mn-421 (3 hrs)	Procurement & Cont Admin Mn-461 (3 hrs)	Org & Mgmt Seminar Mn-495 (3 hrs)	Verbal Area Quality Point Rating	Third Quarter Total Quality Point Rating
11			B	A		A	A	B	2.68	A	A	B	A	B	A	A			2.64	2.66
12			C	C		B			1.25	B	B	B	B	B	B	B	A		2.10	1.81
13			D	D		B			0.50	B	C	B	C	C	B		B	B	1.61	1.23
14			D	D		B			0.50	C	B	D	C	D	B	B	B		1.10	0.89
15			B	B		B		B	2.00	A	B	B	B	B	A	A		A	2.45	2.30
16			B	A		A			2.75	A	C	C	B	B	B	B		B	1.87	2.17
17			B	B		B			2.00	A	B	B	C	B	C	B			1.86	1.91
18			C	B		B			1.75	B	B	B	C	B	A	A		A	2.19	2.04
19	B	B	B			A			2.25	A	A	A	B	A	A	A		A	2.87	2.56
20	C	C	C			E			1.25	B	C	B	A	B	A	A	A	A	2.35	1.93

APPENDIX A

ACADEMIC SCORES

Student Identification Number	Calculus for Mgmt Ma-170 (4 hrs)	Mgmt Statistics Ma-371 (4 hrs)	Financial Mgmt I Mn-420 (4 hrs)	Quantitative Methods Mn-470 (8 hrs)	Ops Analysis for Mgmt OA-471 (4 hrs)	EDP & Mgmt Control Ma-471 (3 hrs)	Industrial Mgmt Mn-440 (4 hrs)	Economic Analysis Mn-413 (3 hrs)	Adv. Cost Accounting Mn-423 (3 hrs)	Quantitative Area Quality Point Rating	Mgmt Psychology Mn-452 (4 hrs)	Material Mgmt Mn-463 (3 hrs)	Org. Theory & Mgmt Mn-490 (5 hrs)	Financial Mgmt II Mn-421 (4 hrs)	Mgmt Economics Mn-410 (5 hrs)	Pers Admin & Ind Rel Mn-453 (4 hrs)	Auditing Mn-421 (3 hrs)	Procurement & Cont Admin Mn-461 (3 hrs)	Org. & Mgmt Seminar Mn-493 (3 hrs)	Verbal Area Quality Point Rating	Third Quarter Total Quality Point Rating
21		A	A	A			B		A	2.75	A	C	B	A	A	B			A	2.45	2.55
22	A	B	A	A	A	B			B	2.63	A	A	A	B	A				B	2.57	2.60
23		B	B	B			B		A	2.00	B	B	B	B	A			B	A	2.35	2.23
24	B	C	C		B	C		B	B	1.42	B	A	B	A	A			B	B	2.45	2.06
25	B	B	B	B	B	B	B	B	C	2.00	B	B	C	C	B					1.48	1.72
26			B	B			A		B	2.00	B	A	B	A	B			B		2.36	2.21
27			B	C			B		A	2.25	B	A	B	C	A	A			A	2.45	2.38
28			C	B			B		A	1.25	B	B	B	B	B	B			B	2.13	1.83
29		A	A					A	A	2.37	A	B	B	A	B		A	A		2.54	2.46
30	D	B	B				B	B	A	1.58	A	B	A	B	B		A	A	B	2.45	2.42

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ACADEMIC SCORES

Student Identification Number	Calculus for Mgmt Ma-170 (4 hrs)	Mgmt Statistics Ma-371 (4 hrs)	Financial Mgmt I Mn-420 (4 hrs)	Quantitative Methods Mn-470 (8hrs)	Ops Analysis for Mgt OA-471 (4 hrs)	EDP & Mgmt Control Ma-471 (3 hrs)	Industrial Mgmt Mn-440 (4 hrs)	Economic Analysis Mn-413 (3 hrs)	Adv. Cost Accounting Mn-423 (3 hrs)	Quantitative Area Quality Point Rating	Mgmt psychology Mn-452 (4 hrs)	Material Mgmt Mn-463 (3 hrs)	Org. Theory & Mgmt Mn-490 (5 hrs)	Financial Mgmt II Mn-421 (4 hrs)	Mgmt Economics Mn-410 (5 hrs)	Pers Admin & Ind Rel Mn-453 (4 hrs)	Auditing Mn-421 (3 hrs)	Procurement & Cont Admin Mn-461 (3 hrs)	Org & Mgmt Seminar Mn-495 (3 hrs)	Verbal Area Quality Point Total	Third Quarter Total Quality point Rating
			QUANTITATIVE SUBJECTS								VERBAL SUBJECTS										
31	D	D	B			B		B	B	1.16	B	A	B	B	B	B		A		2.36	1.57
32			A	A		A				3.00	A	A	A	A	A			A	A	3.00	3.00
33			B	B		B		B	B	2.00	B	A	A	C	A			A	A	2.50	2.30
34	C	C	C	C	A	B		B		1.53	B	B	B	B	A				A	2.25	1.96
35			B	A		A		A	B	1.58	B	A	A	B	B	B		B		2.18	1.94
36			A	C	B	B		B	A	3.00	A	B	B	A	B	B				2.57	2.74
37	B	C	C	C		A	B		B	1.37	B	C	C	C	B				A	1.75	1.60
38			B		B	B				1.79	A	A	A	A	B				A	2.86	2.43
39			E	C		E		B	B	1.58	A	B	B	B	A				A	2.36	2.04
40			A	A		A			E	3.00	A	B	B	B	A	A	A	A	A	2.68	2.50

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	VERBAL SUBJECTS											QUANTITATIVE SUBJECTS											
Student Identification Number	Third Quarter Total Quality point Rating	Verbal Area Quality point Rating	Org. & Mgmt Seminar Mn-495 (3 hrs)	Procurement & Cont Admin Mn-461 (3 hrs)	Auditing Mn-421 (3 hrs)	Pers Admin & Ind Rel Mn-453 (4 hrs)	Mgmt Economics Mn-410 (5 hrs)	Financial Mgmt II Mn-421 (4 hrs)	Org. Theory & Mgmt Mn-490 (5 hrs)	Material Mgmt Mn-463 (3 hrs)	Mgmt Psychology Mn-452 (4 hrs)	Quantitative Area Quality point Rating	Cost Accounting Mn-423 (3 hrs)	Adv. Cost Analysis Mn-413 (3 hrs)	Economic Mgmt Mn-440 (4 hrs)	Industrial Mgmt Ma-471 (3 hrs)	EDP & Mgmt Control QA-471 (4 hrs)	Ops Analysis for Mgmt Mn-470 (8hrs)	Quantitative Methods Mn-420 (4 hrs)	Financial Mgmt I Ma-371 (4 hrs)	Mgmt Statistics Ma-170 (4 hrs)	Calculus for Mgmt
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
41	2.00	2.13	B		B	A	B	B	B	B	B	1.75			B			B	C			
42	2.06	1.96			B	B	C	A	B	B	B	2.21	B		B			B	A			E
43	2.06	2.21	A			B	B	B	B	A	B	1.84				C	B		B	B	E	B
44	2.09	2.32				B	A	B	B	A	B	1.82		B	B	B	B		C	B	B	B
45	2.32	2.29			B	B	A	B	B	A	B	2.37	A		B			B	A			
46	2.49	2.74	A	A		A	B	A	A	B	A	2.00		A	A			B	C			
47	1.50	1.90	A		B	B	C	A	C	B	B	1.00			A			D	C			
48	1.65	1.82			A	B	C	B	B	C	B	1.42	C		B			C	B			
49	2.70	3.00	A			A	A	A	A	A	A	2.26					B		A	B	A	A
50	2.30	2.39			B	B	B	A	B	A	A	2.18	A	A			B			A	B	B

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Student Identification Number	Calculus for Mgmt Ma-170 (4 hrs)	Mgmt Statistics Ma-371 (4 hrs)	Financial Mgmt I Mn-420 (4 hrs)	Quantitative Methods Mn-470 (8 hrs)	Ops Analysis for Mgt QA-471 (4 hrs)	EDP & Mgmt Control Ma-471 (3 hrs)	Industrial Mgmt Mn-440 (4 hrs)	Economic Analysis Mn-413 (3 hrs)	Adv. Cost Accounting Mn-423 (3 hrs)	Quantitative Area Quality point Rating	Mgmt Psychology Mn-452 (4 hrs)	Material Mgmt Mn-463 (3 hrs)	Org. Theory & Mgmt Mn-490 (5 hrs)	Financial Mgmt II Mn-421 (4 hrs)	Mgmt Economics Mn-410 (3 hrs)	Pers Admin & Ind Rel Mn-453 (4 hrs)	Auditing Mn-421 (3 hrs)	Procurement & Cont Admin Mn-461 (3 hrs)	Org & Mgmt Seminar Mn-495 (3 hrs)	Verbal Area Quality point Rating	Third Quarter Total Quality point Rating
51	B	B	A		B	B			A	2.32	A	B	B	B	B					2.12	2.12
52	A	A	A		B	A			A	2.82	A	A	A	A	B					2.84	2.83
53			C	B			C		A	1.82	B	B	D	C	C					1.32	1.55
54	B	C	B		C	C			A	1.64	B	A	B	B	B					2.36	2.02
55			C	C			B			1.25	B	C	B	C	B	B	B	B	B	1.68	1.53
56			D	D			B			0.75	B	B	B	B	B	B	B	A	A	2.10	1.64
57			B	B			B			2.00	B	B	B	B	B	B	B	B	B	2.00	2.00
58		A	B		B	B				2.21	A	B	B	A	B				B	2.29	2.26
59	B	C	C		B	C				1.42	B	B	B	B	A			B		1.96	1.74
60				E		B	B	B		2.00	A	A	A	B	A		B		B	2.94	2.43

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ACADEMIC SCORES

	VERBAL SUBJECTS										QUANTITATIVE SUBJECTS										
Student Identification Number	Third Quarter Total Quality Point Rating	Verbal Area Quality Point Rating	Org. & Mgmt Seminar Mn-493 (3 hrs)	Procurement & Cont Admin Mn-461 (3 hrs)	Auditing Mn-421 (3 hrs)	Pers Admin & Ind Rel Mn-453 (4 hrs)	Mgmt Economics Mn-410 (5 hrs)	Financial Mgmt II Mn-421 (4 hrs)	Org. Theory & Mgmt Mn-490 (3 hrs)	Material Mgmt Mn-463 (3 hrs)	Mgmt Psychology Mn-452 (4 hrs)	Quantitative Area Quality Point Rating	Adv. Cost Accounting Mn-423 (3 hrs)	Economic Analysis Mn-413 (3 hrs)	Industrial Mgmt Ma-440 (4 hrs)	EDP & Mgmt Control Ma-471 (3 hrs)	Ops Analysis for Mgmt OA-471 (4 hrs)	Quantitative Methods Mn-470 (8hrs)	Financial Mgmt I Mn-420 (4 hrs)	Mgmt Statistics Ma-371 (4 hrs)	Calculus for Mgmt Ma-170 (4 hrs)
61	2.00	1.82					B	B	B	B	B	1.58		B			B		C	C	B
62	2.16	2.04					A	B	B	B	B	1.91		A		A	B		C	B	C
63	2.26	2.26	B	B		A	B	A	B	B	B	2.25	A	B	B			A	C	C	
64	2.35	2.48			A	A	B	B	B	A	A	2.64	A	A	B		A	A	B	B	
65	2.75	2.36	A			A	B	A	A	B	B	1.79	A	B	A	B	B	B	R	R	C
66	2.36	2.34			B	A	B	A	B	B	B	2.32			B	C		C	C	A	C
67	1.50	1.27			B	B	C	B	A	B	A	0.79	B			B	B	D	A	C	D
68	2.43	2.34			A	B	B	A	B	A	B	2.21		B	B	B	B	B	B	A	B
69	1.80	1.92				B	B	A	B	C		1.82				B	B	C	C	C	S
	2.10	1.9	B		B	B	B	B	A	C	C	0.25			B		C	C	B	C	

APPENDIX A

ACADEMIC SCORES

Student Identification Number	Calculus for Mgmt Ma-170 (4 hrs)	Mgmt Statistics Ma-371 (4 hrs)	Financial Mgmt I Mn-420 (4 hrs)	Quantitative Methods Mn-470 (8hrs)	EDP & Mgmt Control OA-471 (4 hrs)	Ops Analysis for Mgt Ma-471 (3 hrs)	Industrial Mgmt Mn-440 (4 hrs)	Economic Analysis Mn-413 (3 hrs)	Adv. Cost Accounting Mn-423 (3 hrs)	Quantitative Area Quality Point Rating	Mgmt Psychology Mn-452 (4 hrs)	Material Mgmt Mn-463 (3 hrs)	Org. Theory & Mgmt Mn-490 (5 hrs)	Financial Mgmt II Mn-421 (4 hrs)	Mgmt Economics Mn-410 (5 hrs)	Pers Admin & Ind Rel Mn-453 (4 hrs)	Auditing Mn-421 (3 hrs)	Procurement & Cont Admin Mn-461 (3 hrs)	Org & Mgmt Seminar Mn-493 (3 hrs)	Verbal Area Quality Point Total	Third Quarter Quality point Rating
E1	C	A	B			B				2.25	A	A	A	A	A	A	A		A	3.00	2.74
E2	C	C		B	C				A	1.42	B	C	B	B	B	B			A	1.96	1.74
E3	B	B		C	B			A	A	1.95	B	A	A	B	B	A				2.68	2.34
E4	B	B		B	A		A		A	2.27	B	B	A	B	A	A			A	2.94	2.42
E5	B	B	B	B	A	B	A		A	2.45	A	B	B	A	A	A				2.64	2.45
E6	A	A	A			B	A	A	A	2.45	A	B	B	A	A	A	A			2.32	2.38
E7	A	A	C			E		A	A	2.79	A	C	A	A	B	B	A	A	A	2.55	2.64
E8	C	C	C			E				1.25	A	B	A		A	A	A	A	B	2.20	2.24
E9	C	C				B			B	1.25	B	C	B	B	A	B	A	A		2.06	1.79
E10						B		B	B	1.35	A	B	B	B	B	B	B	A		2.20	1.37

APPENDIX A

ACADEMIC SCORES

Identification Number	Calculus for Mgmt Ma-170 (4 hrs)	Mgmt Statistics Ma-371 (4 hrs)	Financial Mgmt I Mn-420 (4 hrs)	Quantitative Methods Mn-470 (8hrs)	Ops Analysis for Mgt OA-471 (4 hrs)	EDP & Mgmt Control Ma-471 (3 hrs)	Industrial Mgmt Mn-440 (4 hrs)	Economic Analysis Mn-413 (3 hrs)	Adv. Cost Accounting Mn-423 (3 hrs)	Quantitative Point Rating / Quantitative Area	Mgmt Psychology Mn-452 (4 hrs)	Material Mgmt Mn-463 (3 hrs)	Org. Theory & Mgmt Mn-490 (5 hrs)	Financial Mgmt II Mn-421 (4 hrs)	Mgmt Economics Mn-410 (5 hrs)	Pers Admin & Ind Rel Mn-453 (4 hrs)	Auditing Mn-421 (3 hrs)	Procurement & Cont Admin Mn-461 (3 hrs)	Org & Mgmt Seminar Mn-493 (3 hrs)	Verbal Area Quality Point Rating	Third Quarter Total Quality Point Rating
81	A	B		B	C					2.05	A	B	A	B	A	A				2.64	2.40
82	A	A		A	A			A	A	3.00	A	A	B	A	A				A	2.86	2.92
83		A	A	B		B	B		B	2.63	A	A	A	A	B	A				2.70	2.68
84		B	B		B	A		A	A	2.16	B	B	B	C	A	A				1.93	2.02
85		A	A	B		B	B		A	2.79	B	B	B	C	A	A				2.52	2.45
86		C	B		B	B				1.95	B	C	B	B	B	A		B	B	1.84	1.81
87		B	C		B	B				1.60	B	A	B	C	A	A			B	2.29	1.98
88	B	B	A		E	A		A	A	2.45	B	B	B	B	A					2.16	2.30
89	B		A		A			A		2.82	B	C	B	B	B					1.96	2.34
90		B	C	B	B					1.50	B	C	A	B	B	A				2.16	1.94

APPENDIX A

ACADEMIC SCORES

Student Identification Number	Calculus for Mgmt Ma-170 (4 hrs)	Mgmt Statistics Ma-371 (4 hrs)	Financial Mgmt I Mn-420 (4 hrs)	Quantitative Methods Mn-470 (8hrs)	Ops Analysis for Mgt OA-471 (4 hrs)	EDP & Mgmt Control Ma-471 (3 hrs)	Industrial Mgmt Mn-440 (4 hrs)	Economic Analysis Mn-413 (3 hrs)	Adv. Cost Accounting Mn-423 (3 hrs)	Quantitative Area Quality Point Rating	Mgmt Psychology Mn-452 (4 hrs)	Material Mgmt Mn-463 (3 hrs)	Org. Theory & Mgmt Mn-490 (5 hrs)	Financial Mgmt II Mn-421 (4 hrs)	Mgmt Economics Mn-410 (5 hrs)	Pers Admin & Ind Rel Mn-453 (4 hrs)	Auditing Mn-421 (3 hrs)	Procurement & Cont Admin Mn-461 (3 hrs)	Org & Mgmt Seminar Mn-495 (3 hrs)	Verbal Area Quality Point Rating	Third Quarter Total Quality Point Rating
91		B	A		B			A	A	2.58 B	A	B	B	B	B	B			B	2.11	2.30
92	C	C			B			B		1.25 B	A	B	B	B	B		A	A	A	2.29	1.24
93		C	B		A			B		2.00 B	B	B	A	B	A			B	B	2.35	2.23
9_		B	B		B			B	B	2.00 A	B	B	B	B	B			A	A	2.25	2.15

APTITUDE TEST SCORES

Student Identification Number	Orig. OCB & OQT -Math	Orig. OCB & OQT-Verbal	Orig OCB & OQT-Total	Second OCB- Math	Second OCB - Verbal	Second OCB - Total	OQT - Math	OQT - Verbal	OQT - Total	GRE - Math	GRE - Verbal	GRE - Total	Orig OCB - Math	Orig OCB - Verbal	Orig OCB - Total	Quantitative QPR	Verbal QPR	Third Quarter Total	QPR

APTITUDE TEST SCORES

Student Identification Number	Orig OCB & OQT-Math	Orig OCB & OQT-Verbal	Orig OCB & OQT-Total	Second OCB-Math	Second OCB - Verbal	Second OCB - Total	OQT - Math	OQT - Verbal	OQT - Total	GRE - Math	GRE - Verbal	GRE - Total	Orig OCB - Math	Orig OCB - Verbal	Orig OCB - Total	Quantitative QPR	Verbal QPR	Third Quarter Total	QPR
60	4	49.4	57	62	59.8	60	41	49.4	52	60	59.5				2.68	2.64	2.66		
30	43	43.3	46	57	53.2	60	43	45.9	57	36	43.9				4.25	2.74			

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APPENDIX B

APTITUDE TEST SCORES

Student Identification Number	Orig OCB & OQT-Math	Orig OCB & OQT-Verbal	Orig OCB & OQT-Total	Second OCB- Math	Second OCB - Verbal	Second OCB - Total	OQT - Math	OQT - Verbal	OQT - Total	GRE - Math	GRE - Verbal	GRE - Total	Orig OCB - Math	Orig OCB - Verbal	Orig OCB - Total	Quantitative QPR	Verbal QPR	Third Quarter Total QPR
21	62	61	61.4	59	70	66.3			67	67	67.0	62	64	12.55	2.55	2.55		
22					68	69.2			73	61	65.8			2.63	2.50	2.50		
23		48	48.4	49	51	50.4				55	64.0	48	63					
24					63	58.4												
25																		
26		63																
27																		
28																		
29																		
30																		

APTITUDE TEST SCORES

Student Identification Number	Orig OCB & OQT-Math	Orig OCB & OQT-Verbal	Orig OCB & OQT-Total	Second OCB-Math	Second OCB - Verbal	Second OCB - Total	OQT - Math	OQT - Verbal	OQT - Total	GRE - Math	GRE - Verbal	GRE - Total	Orig OCB - Math	Orig OCB - Verbal	Orig OCB - Total	Quantitative QPR	Verbal QPR	Third Quarter Total QPR
31	59	41.0	29	41.0	49	69	61.0	59	29	44.0	58	67	63.4				1.16	2.34	1.85
32				46	57.2	63					58	61.1				3.00	3.00	3.00
33				66	50.8	42					56	62.0		64	65	2.00	2.50	2.30
34			56	50							52	52.4	54		59			
35			56								52	56.5	54					
36												64.6						
37		33.0	18	38	61.0	48	33	33.0	48		54	57.4						
38	38.4	18		58.4			38	47.3	53		56							
39																		
40											56	63.3						

APTITUDE TEST SCORES

Student Identification Number	Orig OCB & OQT-Math	Orig OCB & OQT-Verbal	Orig OCB & OQT-Total	Second OCB-Math	Second OCB - Verbal	Second OCB - Total	OQT - Math	OQT - Verbal	OQT - Total	GRE - Math	GRE - Verbal	GRE - Total	Orig OCB - Math	Orig OCB - Verbal	Orig OCB - Total	Quantitative QPR	Verbal QPR	Third Quarter Total QPR
41			40	49	45.9				47	54	54				1.75	2.13	2.00	
42			42	60	52.8				54	43	47.4				2.27	.96	2.04	
43	69	53	59	40	60.4	49	53	59	68	55	50.2				1.83	2.02	2.00	
44	49	44	46	40	52.8	49	44	55	73	48	49				1.83	2.32		
45		49								63	49				2.00	1.28	2.42	
															2.00			
								43	39	40.3								
		53		49							68.4							
				48						66								
42	69																	

Student Identification Number	Orig OCB & OQT-Math	Orig OCB & OQT-Verbal	Orig OCB & OQT-Total	Second OCB-Math	Second OCB - Verbal	Second OCB - Total	OQT - Math	OQT - Verbal	OQT - Total	GRE - Math	GRE - Verbal	GRE - Total	Orig OCB - Math	Orig OCB - Verbal	Orig OCB - Total	Quantitative QPR	Verbal QPR	Third Quarter Total QPR
54	63	65	64.1	60	63	54.6			73	54	62.9	63	65	64.	62.3	42.3	64.	29.21
52	52	67	54.		67	63.9			74	55	69.3	62	57	64.	62.8	42.8	42.8	0.33
53				49	45	46.0			56	37	45							

APPENDIX B

APTITUDE TEST SCORES

Student Identification Number	Orig OCB & OQT-Math	Orig OCB & OQT-Verbal	Orig OCB & OQT-Total	Second OCB-Math	Second OCB - Verbal	Second OCB - Total	OQT - Math	OQT - Verbal	OQT - Total	GRE - Math	GRE - Verbal	GRE - Total	Orig OCB - Math	Orig OCB - Verbal	Orig OCB - Total	Quantitative QPR	Verbal QPR	Third Quarter Total QPR
61	58	55.9	57	58	63.3		53			53	52	54.5	53	53	55.4	582.00	582.00	1.82
62	54	51.6	54	60	61.9		56			56	52	53.9	49	54	51.41.9	2.16	2.04	
63							52				46	48.			2.26	2.26		

APTITUDE TEST SCORES

Student Identification Number	Orig OCB & OQT-Math	Orig OCB & OQT-Verbal	Orig OCB & OQT-Total	Second OCB-Math	Second OCB - Verbal	Second OCB - Total	OQT - Math	OQT - Verbal	OQT - Total	GRE - Math	GRE - Verbal	GRE - Total	Orig OCB - Math	Orig OCB - Verbal	Orig OCB - Total	Quantitative QPR	Verbal QPR	Third Quarter Total QPR
71	57	54	55.0	54	52	52.7			66	57	57	60.0	57	54	55.02	2.25	3.00	2.74
72	57	53	58.4	56	54	54.8			65	47	54.2		67	53	58.6	1.48	1.96	1.74
73	49	49	49.0	54	50	55.3			59	43	50.5		49	40	40.0	2.48	2.82	34

Student Identification Number	Orig OCB & OQT-Math	Orig OCB & OQT-Verbal	Orig OCB & OQT-Total	Second OCB-Math	Second OCB-Verbal	Second OCB-Total	OQT-Math	OQT-Verbal	OQT-Total	GRE-Math	GRE-Verbal	GRE-Total	Orig OCB-Math	Orig OCB-Verbal	Orig OCB-Total	Quantitative QPR	Verbal QPR	Third Quarter Total QPR
81	62	50	60.3	72	73	72.6			71		63	61.5,0	62	60	60.0,82.05	2.64	2.64,2.40	
82				69	73	66.9			65		63	64.3			3.00,2.8		2.8	2.93
81				50		52.6			74		69	4.0			2.63			2.55

APTITUDE TEST SCORES

Student Identification Number	Orig OCB & OQT- Math	Orig OCB & OQT-Verbal	Orig OCB & OQT-Total	Second OCB- Math	Second OCB - Verbal	Second OCB - Total	OQT - Math	OQT - Verbal	OQT - Total	GRE - Math	GRE - Verbal	GRE - Total	Orig OCB - Math	Orig OCB - Verbal	Orig OCB - Total	Quantitative QPR	Verbal QPR	Third Quarter Total QPR

APPENDIX B